Nation runs from 5 to 13 inches, but the variation by months or years shows a wide range, varying from one-half to twice the average. Over one-third of the rainfall may be credited to July, August and September; about 12 per cent. to April, May and June.

(To be continued)

ON THE MARINE MOLLUSCA OF STATEN ISLAND, N. Y.

BY ARTHUR JACOT.

During the past summer I was enabled to continue a study of the shells to be found along the southeast shore of Staten Island working beyond the region reported upon in the January (1919) number of "THE NAUTILUS."

A week was spent at Great Kills Bay and vicinity. This bay was formed by a sand-spit dropped by the lower New York Bay waters as they struck the current of the Kills which flow out at this point. Though half a mile narrower than its width (one mile), the bay is very shallow; the upper section, enclosed by high grasses except at the base of the sand-spit, is but two feet deep at low tide and covered with eel-grass, while the lower section is lined on the land side with cottages, hotels, piers, etc., is free from eel-grass, averages six to seven feet deep at low tide and is choked with launches and oyster boats. Throughout its extent, the bottom is formed of a soft, sticky clay, which mixes readily with the water. Due to this clay, the number of gasoline boats, and possibly the sewers near the entrance, the molluscan fauna consists of the hardiest species only.

Although we diluted and strained clay for hours at a time at the stations indicated, we found very few species. At one locality, dug-up clay mixed with a little sand yielded shells which from their leached-out appearance might be considered fossil. These fossil shells were much more numerous than those found above them on the surface. *Barnea truncata*, whose valves I have found in abundance lying on the bottom of the upper part of the bay a year and a half before, was not noticed.

Alectrion obsoleta was everywhere very abundant, the shell reaching a length of an inch, and occasionally having the surface largely eaten away. One was found with a prominent, biangulate carina just above the center of the body whorl so that it appears immediately above the suture on the penultimate whorl, becoming obsolete half way around that whorl. The other shells found, not including the countless fragments, were:

Macoma balthica (Linné) few, mostly young.
Mya arenaria Linné few, mostly young,
Odostomia impressa (Say) few.
Odostomia trifida (Totten) fairly common.
Odostomia bisturalis (Say) few.
Crepidula fornicata Linné occasional.
Paludestrina minuta (Totten) rare.
Lacuna vincta fusca Gould one.

The fossil shells include:

Mya arenaria (Linné) few.
Crepidula fornicata Linné few.
Crepidula glauca convexa Say few.
Crepidula plana Say rare.
Bittium alternatum (Say) The only specimen found measures 7.25 mm. in length by 2.5 mm. in width and has eight closely crowded spiral bands on each of the last two whorls.
Alectrion obsoleta (Say) abundant.
Alectrion trivittata (Say) few.
Urosalpinx cinerea (Say) occasional.

At the base of the sand-spit there is a small influx of sand where the waters of the bay have been cutting across during the last two or three years, and a new fauna is being introduced consisting of:

Venus mercenaria Linné young.
Gemma gemma purpurea (H. C. Lea) abundant.
Mya arenaria (Linné) few.
Ensis directus (Conrad) few.
Crepidula fornicata Linné few.
Alectrion obsoleta (Say) occasional.

Alectrion trivittata (Say) common.
Eupleura caudata (Say) few.
Urosalpinx cinerea (Say) occasional.

The sod-bank or *Modiolus demissus* association was to be found on any clay or hard-mud bank exposed between tides. This association consists principally of *Modiolus demissus plicatulus* packed tight one against the other or separated by *Mytilus edulis* packed just as closely, over both of which crawl *Litorina littorea* and *L. rudis*. *Modiolus demissus demissus* is found very thinly scattered among the individuals of the northern form. That the southern variety was once the predominant form over this area is evident from the fact that the sod banks on which *plicatulus* is now living contain the dead valves of the southern form exclusively, in large numbers and buried to a depth of 8 or 10 inches below the surface in company with *Mya arenaria*. I do not think the two forms interbreed.

Half a mile southeast of the bay where there is a stone jetty running out into water four to five feet deep at low tide, the rocks and bottom were searched but with very discouraging results. The water all along this section of the island is heavily laden with fine mud from the red dirt characteristic of that part of the island. This we believe to be the reason for the scarcity of mollusca along the beaches southeastward. A shattered but uneroded and still united pair of valves of *Modiolus modiolus* (Linné) were found at Seaside Beach.

Our survey of the island showed the north and northeast shore of the island to be rocky and built over by commercial interests. From Fort Wadsworth to Prince's Bay (the southeast cost) there are sandy beaches interrupted by sod-banks. As one progresses southeastward these beaches become more and more rocky to Prince's Bay, from which point and around the southern end of the island the shore is characteristically rocky. The remaining (western) coast line is lost in a maze of salt marsh. Thus there are but two places along the southeast coast of Staten Island where Mollusca are of special interest, namely, the sand flats between South and Midland Beaches and the complex about the base of the Great Kills Bay spit. The southern end of the island was not studied.

In connection with this work I have endeavored to learn what work has already been done on the Mollusca of Staten Island. The literature is as follows:

Wheatley, Charles M., Catalogue of the Shells of the United States and their Localities, 12 pp., 1842 & 1845.

Eleven species are here listed as coming from S. I., of which *Periploma leanum*, *Pandora gouldiana*, *Lyonsia hyalina* and *Astarte castanea* are mentioned as fairly common or abundant. The last one I have not as yet found on the island although it is found on the Long Island ocean beaches in increasing abundance with distance from the city.

DeKay, James E., Nat. Hist. of N. Y., Zoölogy of N. Y., Mollusca, 271 pp., 40 pls., 1843.

Pandora gouldiana, *Pholas truncata*, *Odostomia trifida*, *Columbella avara* and *C. lunata* are recorded from the island on the authority of Wheatley.

Hubbard, Eber[1] Ward & Smith, Sanderson, Catalogue of the Mollusca of Staten Island, Annals of the Lyceum of Nat. Hist. of N. Y., vol. 7, pp. 151–154, 1865.

This paper is revised in:

Smith, S., Catalogue of the Mollusca of S. I., Nat. Sci. Ass. of S. I., Proc., vol. 1, p. 35, 1886 and p. 50, 1887.

Of the 78 species listed, *Solemya velum*, *Yoldia limatula*, *Nucula proxima*, *Venericardia borealis*, *Rochefortia planulata*, *Cardium mortoni*, *Cumingia tellinoides*, *Siliqua costata*, *Zirfaea crispata*, *Epitonium lineata*, *E. humphreysii*, *Triphoris perversa nigrocincta*, *Cerithiopsis greenii*, *Bittium alternatum*, *Columbella avara*, *Mangilia cerina* (*M. plicata not mentioned*), *and Acteon punctostriata* are the rarer species listed. *Anomia aculeata*, *Pholas costata*, *Martesia smithii*, *Litorina irrorata*, *Natica pusilla*, *Alectrion vibex* and *Haminea solitaria* are of special rarity. I do not know of their having been again reported from the vicinity of the city. *Astarte castanea* is included on authority of Wheatley. The list is largely based on dredgings made about the southern end of the island by Hubbard whose collection was later sold to Crooke, whose collection now forms part of the American Museum col-

[1] The "J" in the literature is an error.

lection. Of these rarest species *Martesia smithii* [Martesia caribaea] is the only one now in the Am. Mus. (local) collection.

Davis, W. T., Variations of *Mya arenaria* on the shores of S. I., Nat. Sci. Ass. of S. I., Proc., vol. 1, p. 20, 1885.

On rocky ground the valves are of moderate size, the ends often broken and the exterior corrugated; in sandy ground the valves are very thin, of even growth, the markings complete, they are beautiful in form and color and of largest size; in peat the valves are very much deformed and much rounded.

On the distribution of *Litorina littoralis*, idem., vol. 1, p. 61, 1888 and vol. 3, p. 50, 1893.

It was first noticed by Mr. Hollick at the Narrows in 1888.

Smith, S., & Prime, Temple, Report on the Mollusca of L. I, and its Dependencies, Ann. Lyc. Nat. Hist. N. Y., vol. 9, pp. 377–417, 1870.

Herein *Odostomia trifida*, *O. bisuturalis*, *Polinices triseriata*, *Paludestrina minuta*, *Litorina rudis*, *L. littoralis* and *Lacuna vincta* are recorded as having their southern limit at S. I. This is certainly not the case with the first four species.

From these records one is struck by the decrease in the fauna accompanying the expansion of the city. One of the important factors in the extermination of the less hardy species is the crowding of the beaches for miles beyond the city limits with cottages and bungalos and the accompanying gasoline boats. This evil is obviated by the purchase of the land for large private estates and clubs.

VITREA (PARAVITREA) MULTIDENTATA AND LAMELLIDENS.

BY GEO. H. CLAPP.

Having recently received a specimen of *V. lamellidens* from Norway, Me., I have gone over my collection with the idea of trying to find if *lamellidens* as it occurs in the north is really the same as the typical form from the Great Smoky Mountains or, as Dr. Pilsbry suggests in Proc. Acad. Nat. Sci., 1903, p. 209, merely "accelerated individuals (of *multidentata*), sporadically occurring."